92-04587/

IMAGE ANALYSIS STUDY OF A BALL MILL FEED SAMPLE FROM THE WINSTON LAKE PLANT OF MINNOVA MINES LIMITED

R. Lastra, W. Petruk and R. Pinard
Mineral Processing Laboratory

January 1990

This document is an unedited internal report prepared primarily for [illegible] It does not represent a final expression of the opinion of the Canada Centre for Mineral and Energy Technology (CANMET)

Ce document est un rapport provisoire non-révisé et rédigé principalement pour [illegible] il ne représente nullement l'expression définitive de l'opinion du Centre canadien de la technologie des minéraux et de l'énergie (CANMET)

Project: 30.05.99

Cost Recovery

CONFIDENTIAL

Job No.: 50024

MINERAL SCIENCES LABORATORIES
DIVISION REPORT MSL 90-1 (CR)

MICROMEDIA

44 pp

Abstract

Image analysis of a ball mill feed sample was performed to determine mineral quantities and liberations of sphalerite, chalcopyrite, pyrrhotite and pyrite. Considering particles with 80% of a given mineral as practically free, the following liberations were obtained: sphalerite and pyrite are liberated at 80% -212 μm; pyrrhotite is liberated at 80% -150 μm and chalcopyrite is liberated at 80% -45 μm. The image analysis also showed that sphalerite in the locked particles tends to be associated with pyrrhotite and to a smaller extent with chalcopyrite.

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Research and Technology
Recherche et Technologie

Canada Centre for Mineral and Energy Technology,
555 Booth Street,
Ottawa, Canada
K1A 0G1

Centre canadien de la technologie des minéraux et de l'énergie,
555, rue Booth,
Ottawa, Canada
K1A 0G1

Your file / Votre référence

Our file / Notre référence

L'analyse d'images d'échantillons d'alimentation d'un moulin de broyage a boulets a été faite pour but de déterminer les quantités de minerais et la libération de sphalérite, chalcopyrite, pyrrhotite et pyrite. Si ont considère que les particules avec 80% d'un minéral sont pratiquement libérés, les libérations suivantes sont obtenues: la sphalérite et la pyrite sont libérées a 80% -212 µm, la pyrrhotite est libéré a 80% -150 µm et la chalcopyrite est libéré a 80% - 45 µm. L'analyse d'images a aussi démontré que la sphalérite dans les particules mixtes est généralement associé avec la pyrrhotite et moins souvent avec la chalcopyrite.

Canada

Image analysis study of a ball mill feed sample from the Winston Lake plant of Minnova Mines Limited

R. Lastra W. Petruk R. Pinard

November 6, 1989
Revised January 4, 1989
Project No: 30.05.99 Cost Recovery
Job. No.: 50024

1 Introduction

An investigation of the ore from the Winston Lake plant of Minnova Mines Limited was undertaken by P. Mainwaring of CANMET in 1988. However, Dr. Mainwaring resigned from CANMET before completing the work and writing a report. On July 8, 1989 Mr. D. Hall of Minnova confirmed their interest in the project. The objective of the project was to analyze an ore sample by image analysis and to predict the optimum grind for recovering zinc and copper. An attempt was made to reconstruct what had been done and to re-analyze the samples and interpret the results.

A large sample (roughly 50 kg), labelled BMF-September, 1988 and consisting of about -19 mm material ($-3/4$ inch), had been received by Dr. Mainwaring. A portion of the sample has been ground at CANMET to 80% -75μm (200 mesh) and the remainder of the BMF sample had been screened. The ground portion had also been sieved into $+212$, $-212+150$, $-150+106$, $-106+75$, $-75+45$, $-45+37$ and -37 μm fractions ($+65$, $-65+100$, $-100+150$, $-150+200$, $-200+325$, $-325+400$ and -400 mesh). Polished sections had been prepared from each sieved fraction of the ground material. The weight percent of the sieved fractions from the ground portion are given in Table 1. The polished sections were studied with the microprobe SEM-IPS image analysis system (MP-SEM-IPS) to determine mineral quantities in each fraction and the liberations of sphalerite, chalcopyrite, pyrrhotite and pyrite.

Table 1: Sieve analysis of the ground sample (nominally 80% minus 74μm)

SIZE		WEIGHT
μm	mesh	%
+212	+65	0.58
+150	+100	1.17
+106	+150	9.01
+75	+200	33.53
+45	+325	45.20
+38	+400	7.74
-38	-400	2.77
TOTAL		100%

2 Results

2.1 Mineral quantities

Minerals quantities were determined in each size fraction of the ground sample (80%-74μm) by image analysis in Vol. % and converted to Wt. % (Table 2) using appropriate specific gravities. The mineral quantities in the original sample (Table 3) were calculated using the results for each size fraction and considering their weight percent relative to the ground sample. The minerals of Table 2 correspond to those fully listed in Table 3.

2.2 Liberation of minerals

Liberation analysis was performed for the sphalerite, chalcopyrite, pyrite, and pyrrhotite in each polished section by determining the percent of the mineral of interest in each particle that bears the mineral. The results are given in Tables 1 to 28 of the appendix. These tables were produced by sorting the data into classes: the classes given by the first horizontal row are the percent of the mineral of interest in the particles, and the extreme left vertical column of the tables gives the sizes [μm] of the mineral grains. The numbers inside the tables give the area percent of the mineral in each class for each size range.

Table 4 to 7 and Figures 1 to 4 summarize the information of the appendix tables (1 to 28). Table 4 to 7 and Figures 1 to 4 give, as a function of size, the percent of the mineral of interest that is in particles with more than 70%, more than 80%, more than 90% and 100% (totally free) of the mineral.

Table 2: Mineral weight percent of size fraction

MINERAL †	SIZE FRACTION						
	+212μm +65 mesh	+150μm +100 mesh	+106μm +150 mesh	+75μm +200 mesh	+45μm +325 mesh	+38μm +400 mesh	-38μm -400 mesh
Quartz, etc	36.9	18.2	11.7	8.8	17.0	1.4	5.4
Chlorite, etc	25.1	50.9	52.2	32.8	15.2	30.9	23.4
Apatite, etc	1.9	1.8	1.0	1.0	0.6	0.4	1.0
Ilmenite, etc	2.2	1.0	0.9	0.9	0.7	1.1	1.6
Pyrite, etc	5.9	8.9	9.8	14.9	15.9	12.4	12.6
Pyrrhotite	9.3	6.3	7.4	11.5	12.4	13.0	9.9
Chalcopyrite	2.7	1.0	1.1	2.7	2.2	3.2	4.8
Sphalerite	16.0	12.0	15.9	27.4	36.1	37.6	41.4
Cassiterite, etc	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0
TOTAL	100%	100%	100%	100%	100%	100%	100%

†see Table 3 for complete mineral list

Table 3: Quantities of minerals in ball mill feed sample by MP-SEM-IPS

MINERAL	Wt. %
Quartz and minor pyroxene	12.4
Chlorite, plagioclase, biotite, pyroxene, calcite and some quartz	26.4
Apatite, and titanite	0.8
Ilmenite, and some gahnite	0.8
Pyrite and Magnetite	14.5
Pyrrhotite	11.6
Chalcopyrite	2.4
Sphalerite	31.2
Cassiterite, and galena	trace
TOTAL	100%

Table 4: Liberation for sphalerite. Percent of the sphalerite in the size fraction that is in particles with more than 70, more than 80, more than 90 and 100 volumetric percent of the mineral.

Size Fraction		Classes of sphalerite bearing particles			
μm	mesh	+70	+80	+90	free
+212	+65	75.1	74.9	63.8	9.0
+150	+100	85.2	79.4	72.2	20.8
+106	+150	91.5	87.4	79.4	22.4
+75	+200	90.8	88.2	79.9	26.3
+45	+325	93.8	91.5	86.9	55.9
+38	+400	92.6	89.1	80.8	20.6
-38	-400	97.2	96.3	92.2	63.5

For sphalerite (Figure 1 and Table 4), it can be seen that the amount of sphalerite in particles with more than either 70%, 80% or 90% of sphalerite is not substantially increased in size fractions finer than 150 μm (100 mesh). Therefore a grind to 80% -212 μm (-65 mesh) will provide approximately 80% of the sphalerite in particles with 80% of the phase. It is noteworthy that there is an abrupt increase in the amount of totally free sphalerite in the -75+45μm fraction (-200+325 mesh). The increase suggests that there may be a change in texture of the ore at a size of 75μm (200 mesh).

Figure 2 shows that the liberation of chalcopyrite is low for all types of particles (more than 70% to totally free chalcopyrite). Chalcopyrite in +212μm (+65 mesh) is essentially unliberated, on the other hand, the amount of chalcopyrite in particles with more than 70% of the mineral increases to around 40% for the -212+150μm fraction (-65+100 mesh), and to around 70% in the -75+45μm fraction (-200+325 mesh). Hence a change in liberation at 75μm, the size for textural change noted in the sphalerite evaluation, is also present for chalcopyrite.

For the case of pyrite (Figure 3), a similar behaviour to that of sphalerite is observed, and a grind to 80% -212 μm will provide about 82% of the total pyrite in particles with 80% or more pyrite.

Pyrrhotite liberation is different than pyrite, sphalerite or chalcopyrite liberation (Figure 4). The amount of pyrrhotite in particles with more than either 70%, 80% or 90% pyrrhotite is substantially increased between size fractions +150 μm (+100 mesh) and +106 μm (+150 mesh). Therefore the optimal grind for pyrrhotite liberation should be around -100 mesh.

Table 5: Liberation for chalcopyrite. Percent of the chalcopyrite in the size fraction that is in particles with more than 70, more than 80, more than 90 and 100 volumetric percent of the mineral.

Size Fraction		Classes of chalcopyrite bearing particles			
μm	mesh	+70	+80	+90	free
+212	+65	3.9	3.5	3.5	1.9
+150	+100	42.1	32.0	19.2	1.0
+106	+150	47.7	32.2	29.6	0.4
+75	+200	38.3	32.5	22.7	0.7
+45	+325	70.6	62.9	50.1	17.2
+38	+400	59.6	53.8	40.7	2.8
-38	-400	56.9	44.2	28.6	5.2

Table 6: Liberation for pyrite. Percent of the pyrite in the size fraction that is in particles with more than 70, more than 80, more than 90 and 100 volumetric percent of the mineral.

Size Fraction		Classes of pyrite bearing particles			
μm	mesh	+70	+80	+90	free
+212	+65	82.8	74.8	64.6	23.5
+150	+100	85.6	82.8	74.4	18.6
+106	+150	89.7	86.7	80.6	31.2
+75	+200	90.2	88.2	83.3	36.7
+45	+325	96.3	95.0	92.0	64.5
+38	+400	87.8	82.6	59.2	8.9
-38	-400	95.1	93.4	88.3	58.0

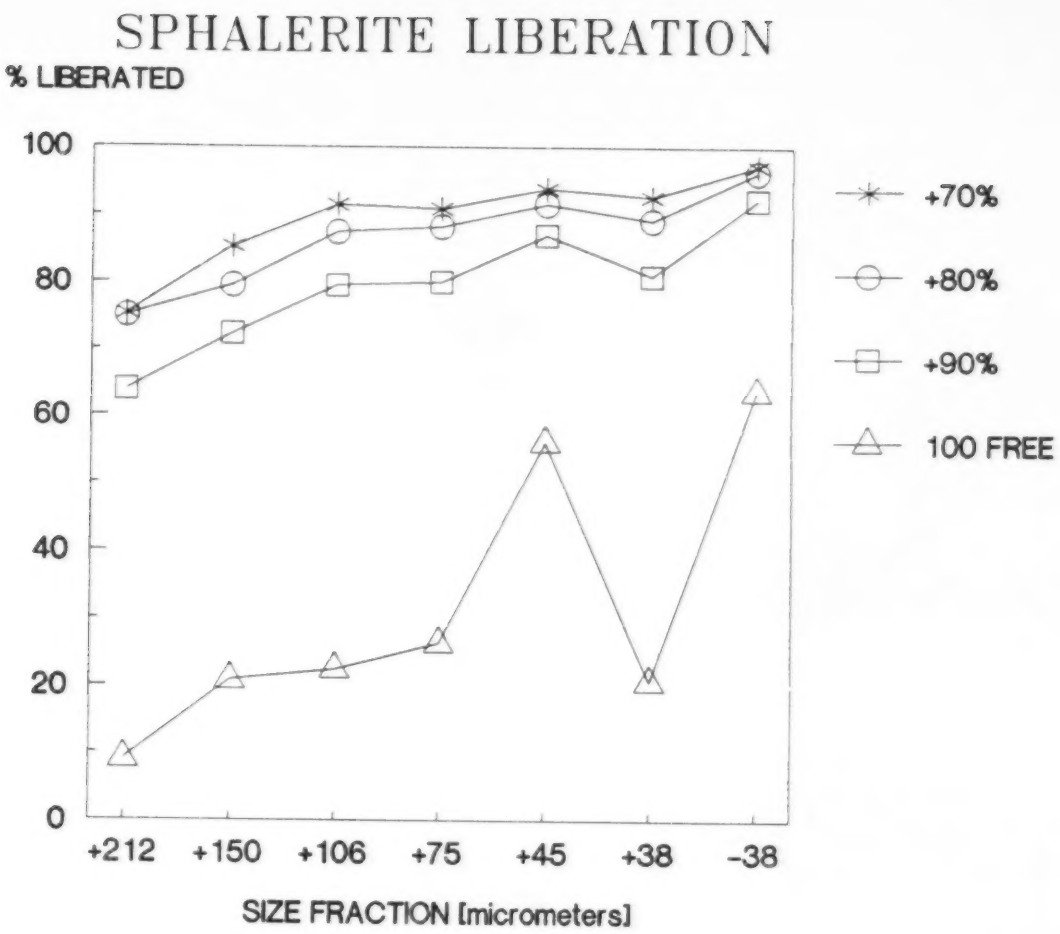

Figure 1: Liberation of sphalerite: Percent of total sphalerite in particles with more than 70% (□), 80% (+), 90% (◇) of sphalerite and totally free sphalerite particles (△) in different size fractions.

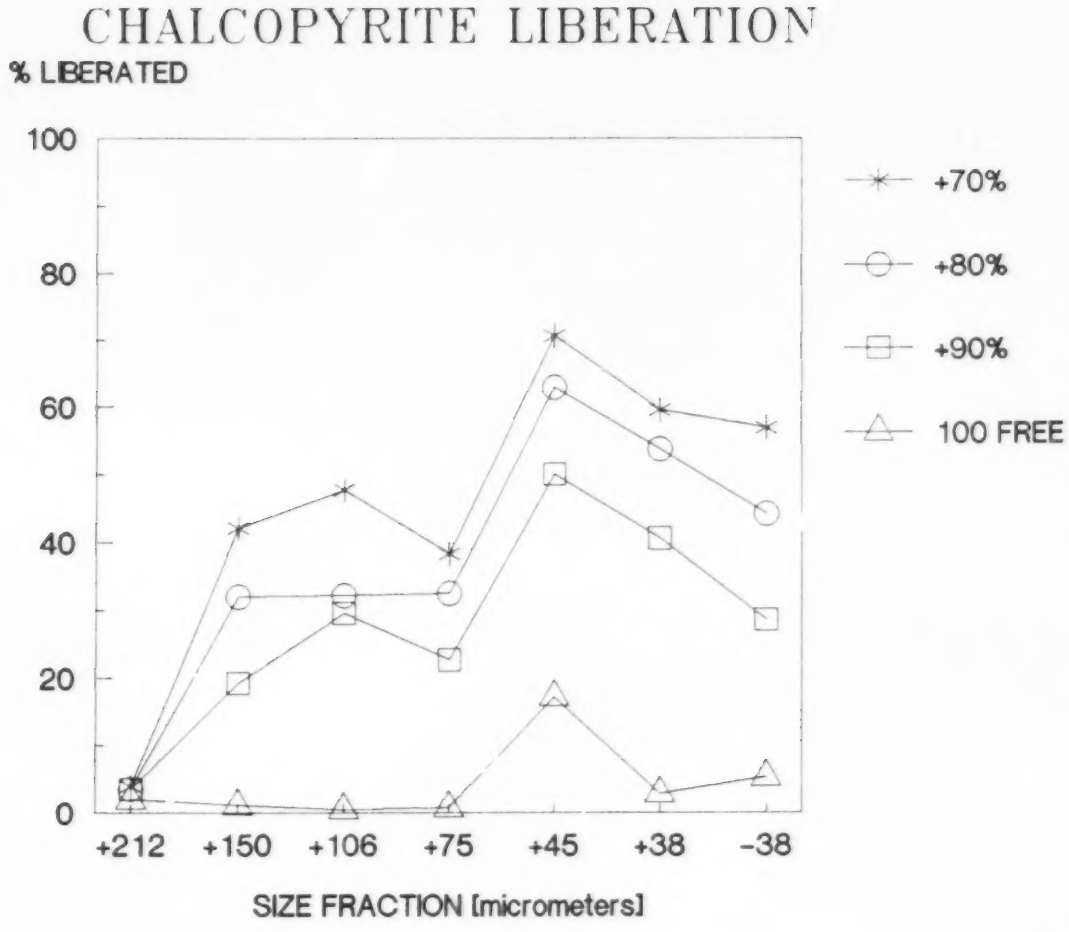

Figure 2: Liberation of chalcopyrite: Percent of total chalcopyrite in particles with more than 70% (□), 80% (+), 90% (◇) of chalcopyrite and totally free chalcopyrite particles (△) in different size fractions.

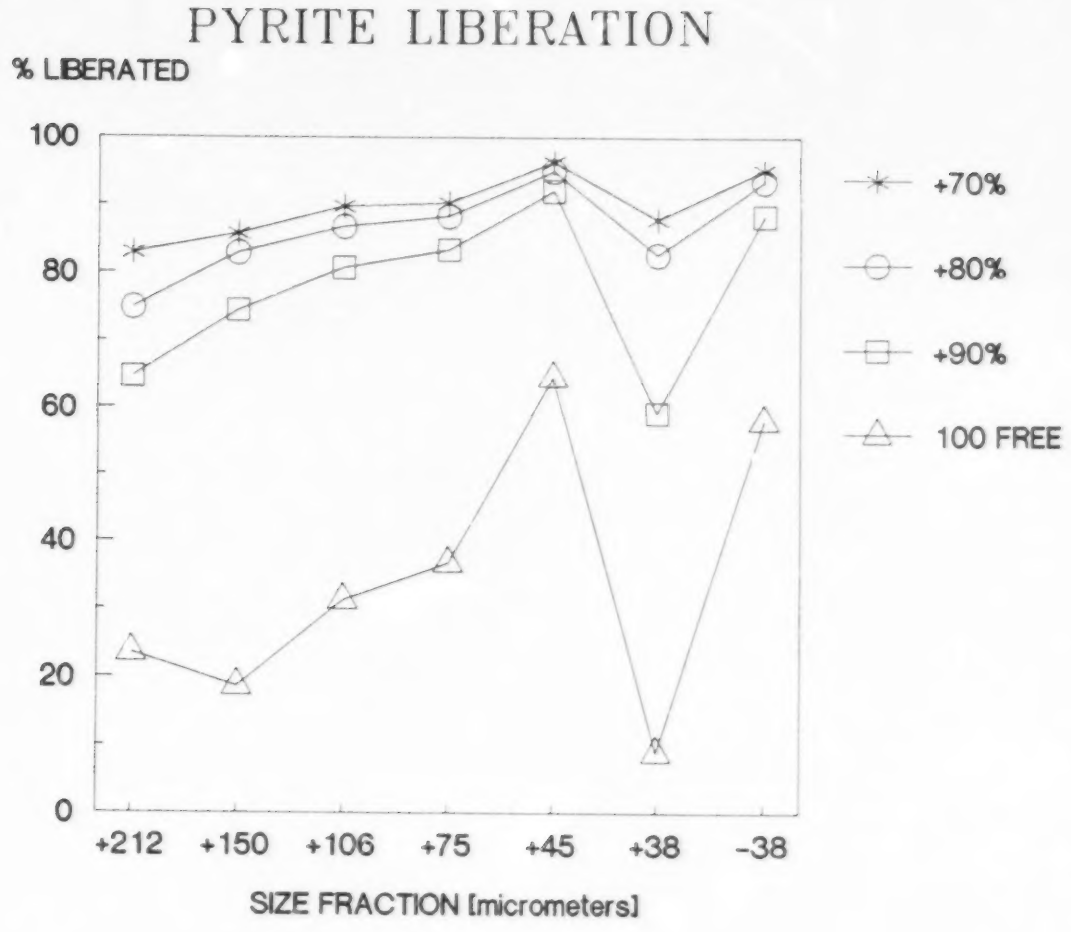

Figure 3: Liberation of pyrite: Percent of total pyrite in particles with more than 70% (□), 80% (+), 90% (◇) of pyrite and totally free pyrite particles (△) in different size fractions.

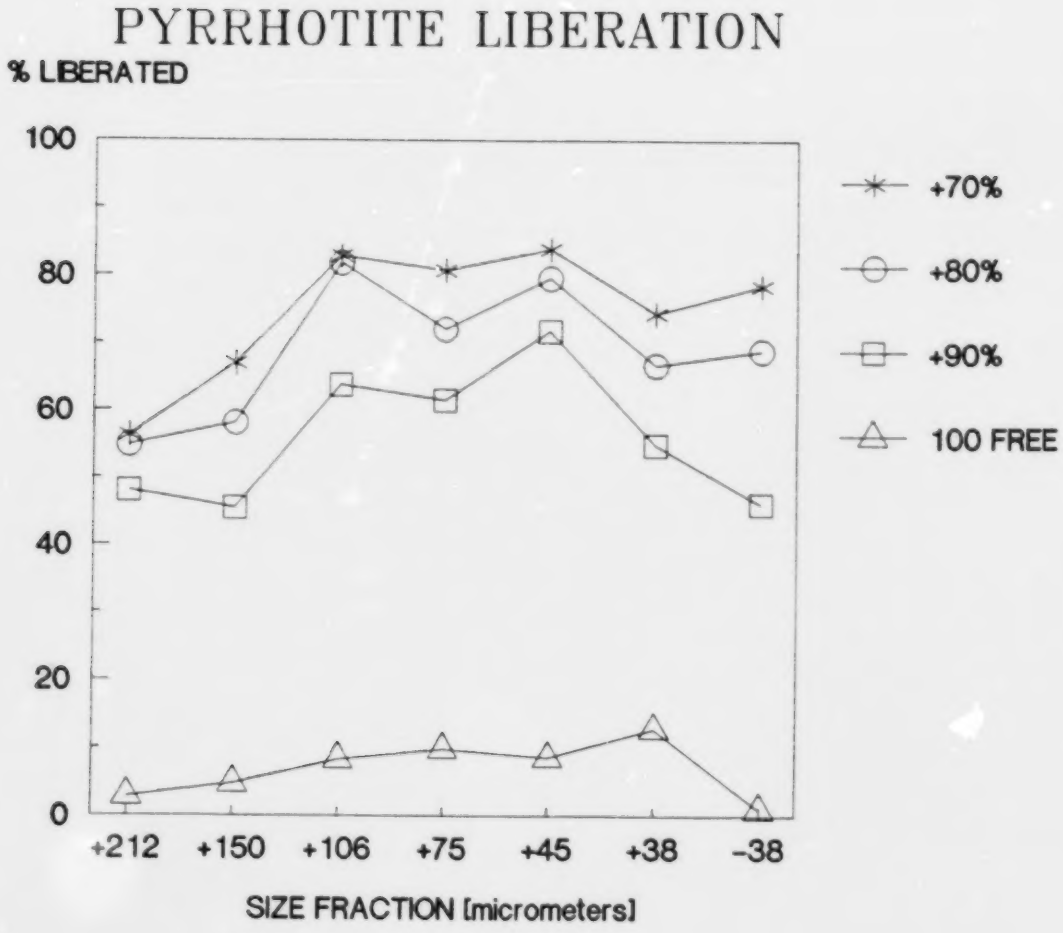

Figure 4: Liberation of pyrrhotite: Percent of total pyrrhotite in particles with more than 70% (□), 80% (+), 90% (◇) of pyrrhotite and totally free pyrrhotite particles (△) in different size fractions.

Table 7: Liberation for pyrrhotite. Percent of the pyrrhotite in the size fraction that is in particles with more than 70, more than 80, more than 90 and 100 volumetric percent of the mineral.

Size Fraction		Classes of pyrrhotite bearing particles			
μm	mesh	+70	+80	+90	free
+212	+65	56.2	54.8	48.0	2.8
+150	+100	66.9	58.1	45.5	4.7
+106	+150	82.7	81.7	63.7	8.3
+75	+200	80.5	71.9	61.4	9.8
+45	+325	83.7	79.4	71.6	8.5
+38	+400	74.2	66.6	54.8	12.7
-38	-400	78.3	68.7	46.1	0.9

2.3 Association of sphalerite with other minerals

The association of sphalerite with the other minerals in the sample was also studied. Table 8 gives the percent of the sphalerite in each size fraction that is free or that is associated with various minerals. The associated sphalerite occurs in particles that contain two minerals and in particles with three or more minerals. Table 9 gives the same information for the combined ground sample (100% sphalerite in 80% -75μm). In these two tables the following abbreviations are used: *sp* is sphalerite, *g* is non-sulphide minerals, *po* is pyrrhotite, *ch* is chalcopyrite, *py* is pyrite, *ot* is an unspecified mineral in tertiary particles. Also it should be noted that the total amount of sphalerite is the sum of columns 2 to 7. The sum of the percent sphalerite (base total sphalerite) in three-mineral particles (columns 9 to 12) can add to more than the figure in column 7; this is because the sphalerite in each of the three-mineral particles bins could have been measured in three of the four ternary associations as other.

Tables 8 and 9 show that the amount of sphalerite in two- mineral particles is small. On the other hand, significant quantities of the total sphalerite measured was found to be associated in three-mineral particles (see column 7), particularly with pyrrhotite and to a smaller extent with chalcopyrite. Table 9 clearly shows that 29% of the total sphalerite in the ground sample is associated in locked tertiary particles with pyrrhotite. Therefore this association of sphalerite should be considered in the operation of the sphalerite concentrator.

Table 8: Percent of the total sphalerite in each size fraction that is associated in various types of locked particles.

SIZE FRAC. μm	Two-mineral particles				free sp	total sp in ternaries	total sp	three-mineral particles			
	sp-g	sp-po	sp-ch	sp-py				sp-g-ot	sp-po-ot	sp-ch-ot	sp-py-ot
1	2	3	4	5	6	7	8	9	10	11	12
+212	2.4	0.4	1.3	0.01	9.0	86.9	100	34.2	46.3	48.9	29.6
+150	1.1	3.4	1.9	0.1	20.8	72.8	100	9.1	48.6	18.5	35.5
+106	0.5	0.5	2.1	0.5	22.4	74.0	100	5.4	46.7	28.6	31.9
+75	0.3	0.6	3.3	0.3	26.7	68.9	100	7.1	42.7	24.3	34.3
+45	0.4	0.4	1.2	0.7	55.9	41.4	100	2.7	15.4	3.9	5.9
+38	0.3	1.7	2.4	0.2	20.6	74.9	100	3.3	55.2	17.2	20.0
-38	1.0	0.6	2.4	0.6	63.5	31.8	100	3.4	10.7	7.1	6.9

sp=sphalerite; g=gangue; po=pyrrhotite; ch=chalcopyrite; py=pyrite; ot=other minerals

Table 9: Percent of the total sphalerite in the sample that is associated in various types of locked particles at different size fractions.

SIZE FRAC. μm	Two-mineral particles				free sp	total sp in ternaries	total sp	three-mineral particles			
	sp-g	sp-po	sp-ch	sp-py				sp-g-ot	sp-po-ot	sp-ch-ot	sp-py-ot
1	2	3	4	5	6	7	8	9	10	11	12
+212	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	0.3	0.3	0.1	0.1	0.2	0.1
+150	≈ 0	≈ 0	≈ 0	≈ 0	0.1	0.3	0.5	≈ 0	0.2	0.1	0.2
+106	≈ 0	≈ 0	0.1	≈ 0	1.0	3.4	4.6	0.3	2.2	1.3	1.5
+75	0.1	0.2	1.0	0.1	7.9	20.3	29.4	2.1	12.6	7.2	10.1
+45	0.2	0.2	0.6	0.4	29.2	21.6	52.2	1.4	8.1	2.0	3.1
+38	≈ 0	0.2	0.2	≈ 0	1.9	7.0	9.3	0.3	5.2	1.6	1.9
-38	≈ 0	≈ 0	0.1	≈ 0	2.3	1.2	3.7	0.1	0.4	0.3	0.3
TOTAL	0.4	0.6	2.0	0.5	42.5	54.0	100	4.3	28.7	12.6	17.0

3 Conclusions

Assuming that particles with 80% of a given phase represent practically free particles of that phase; the following conclusions and commentaries can be given:

1. Sphalerite is liberated at a grind of 80% -212 μm (-65 mesh). This indicates that sphalerite is coarse grained.
2. Pyrite is also liberated at a grind of 80% -212 μm.
3. Pyrrhotite is liberated at a grind of 80% -150 μm (-100 mesh).
4. Chalcopyrite is more difficult to liberate and it requires a grind of 80% -45 μm (-325 mesh) to obtain a liberation of only 60%.
5. It must be considered that a grind of 80% -212 μm will be enough to liberate sphalerite, however it is possible that sphalerite-rich particles of that coarse size may be difficult to float with conventional flotation cells. On the other hand liberation of chalcopyrite requires a grind of 80% -45 μm; but this grind will give rise to slimes related problems to flotation. Therefore if the circuit requires a unique grind, -74 μm (-200 mesh) will be a good compromise. An energy-sound alternative could be to investigate the use of "flash flotation" to float the coarse sphalerite and then regrind the tails to increase liberation of chalcopyrite and refloat.

APPENDIX

table # 5 SUMS Sp.
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the sp grain microns	Classes of sphalerite-bearing particles [% Vol.] 9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		Size Dist. %
3.35	.530E-01	.211E-01	.102E-01	.932E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.942E-01
4.73	.121	.917E-01	.583E-01	.608E-01	.201E-01	.412E-01	.239E-01	0.00	0.00	0.00	.330E-01	.510
6.69	.431E-01	.156	.135	.279E-01	.862E-01	.167E-01	.654E-01	.704E-01	.260E-01	.806E-02	.984	1.62
9.45	.868E-01	.123	.288	.119	.147	.112	.772E-01	.151	.115	.772E-01	1.24	2.54
13.3	.160	.400E-01	.117	.456E-01	.153	0.00	.865E-01	0.00	.247	.664	1.75	3.26
18.9	.144	.694E-01	0.00	.276	.153	.124	.629E-01	0.00	.104	1.57	1.60	4.11
26.6	.357	.183	.205	0.00	.327	0.00	.308	0.00	.587	1.32	1.92	5.21
37.7	0.00	.408	0.00	0.00	0.00	0.00	0.00	0.00	.463	1.89	.784	3.54
53.2	0.00	0.00	1.33	0.00	.575	0.00	0.00	0.00	0.00	.466	.626	3.00
75.2	0.00	0.00	0.00	0.00	1.26	1.14	2.35	0.00	0.00	7.27	0.00	12.0
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56	14.4	0.00	16.9
150.	0.00	0.00	0.00	0.00	0.00	0.00	3.63	0.00	7.05	10.8	0.00	21.7
212.	0.00	0.00	0.00	0.00	0.00	0.00	9.10	0.00	0.00	0.00	0.00	9.10
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.3	0.00	16.3
Dist. of sphalerite	.965	1.09	2.15	.539	2.72	1.43	15.9	.222	11.1	54.8	9.00	100.0

DEF 523 +65 M MINOVA 512*512

Table A-1: Liberation data for sphalerite in the +212 µm (+65 mesh) size fraction.

table # 5 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the sp grain microns	Classes of sphalerite-bearing particles [% Vol.]										Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.121E-01	.147E-02	.105E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.147E-01
4.73	.226E-01	.126E-01	.155E-01	.649E-02	.460E-02	.251E-02	0.00	0.00	0.00	0.00	.643E-01
6.69	.726E-01	.318E-01	.255E-01	.333E-01	.272E-01	.337E-01	.266E-01	.155E-01	.419E-02	0.00	.221
9.45	.810E-01	.563E-01	.504E-01	.110	.134	.404E-01	.691E-01	.131	.237E-01	.473E-01	1.61
13.3	.202	.367E-01	.553E-01	.655E-01	.814E-01	.150	.212	.239	.329	.256	2.58
18.9	.151	.274	.264	.141	.100	.139	.347	.472	.862	1.17	3.68
26.5	.553E-01	.194	.320	.355	.467	.183	.429	.626	.713	3.13	3.27
37.7	.267	.459	.413	.653	.631	.667	.559	1.18	1.45	9.47	5.21
53.2	0.00	.216	.213	.196	.932	1.21	.923	3.12	2.26	16.5	3.12
75.2	0.00	0.00	0.00	0.00	0.00	.770	.732	0.00	.825	16.3	1.14
106.	0.00	0.00	0.00	0.00	0.00	.737	0.00	0.00	.774	4.53	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of sphalerite	.865	1.34	1.36	1.56	2.38	3.93	3.30	5.79	7.24	51.4	20.8	100.

DEF 523 MINOVA -65+100 512*512

Table A-2: Liberation data for sphalerite in the -212+150 µm (-65+100 mesh) size fraction.

table # 5 SUMS
variable z: PER CENT
variable x: PHASE%
variable y: DIA(MIC)

Diameter of the sp grain microns	Classes of sphalerite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.138E-01	.815E-02	0.00	.215E-02	.236E-02	0.00	0.00	0.00	0.00	0.00	0.00	.264E-01
4.73	.643E-01	.191E-01	.105E-01	.688E-02	.322E-02	.451E-02	.703E-02	0.00	0.00	.408E-02	.372E-01	.158
6.69	.477E-01	.221E-01	.241E-01	.208E-01	.159E-01	.516E-02	.703E-02	.217E-01	.114E-01	0.00	.357	.533
9.45	.214	.110E-01	.123E-01	0.00	.475E-01	.357E-01	.120E-01	.697E-01	.403E-01	0.00	.870	1.31
13.3	.163	.628E-01	.563E-01	0.00	.482E-01	.206E-01	.772E-01	.467E-01	.140	.128	1.03	1.77
18.9	.121	.688E-01	.578E-01	.211	.447E-01	.164	.134	.613E-01	.109	.543	1.43	2.94
26.6	.198	.703	.497	.216	.331	.447	0.00	0.00	1.24	1.67	3.42	8.72
37.7	0.00	.185	0.00	.651	.215	.177	1.16	1.11	1.76	5.56	3.30	14.7
53.2	0.00	0.00	0.00	0.00	.702	.373	.800	1.06	1.13	13.9	5.31	23.3
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67	3.52	19.9	4.84	29.9
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.56	1.25	10.8
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.75	0.00	5.75
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of sphalerite	.622	1.08	.658	1.11	1.41	1.23	2.20	4.04	8.01	57.0	22.4	100.

DEF 523 MINOVA -100+150 512*512

Table A-3: Liberation data for sphalerite in the -150+106 µm (-100+150 mesh) size fraction.

DEF 529 MINOVA 150-200 512*512

table # 5 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the sp grain microns	Classes of sphalerite-bearing particles [% Vol.]											Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		
3.35	.516E-02	.469E-03	.469E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.609E-02
4.73	.126E-01	.459E-02	0.00	.281E-02	.844E-03	.112E-02	0.00	0.00	0.00	0.00	0.00	.219E-01
6.69	.444E-01	.919E-02	.816E-02	.712E-02	.844E-02	.909E-02	.159E-02	.806E-02	.225E-02	.356E-02	.119	.221
9.45	.598E-01	.218E-01	.393E-01	.284E-01	.122E-01	.124E-01	.891E-02	.609E-02	.209E-01	.100E-01	.543	.763
13.3	.196	.507E-01	.742E-01	.264E-01	.520E-01	.497E-01	.220E-01	.658E-01	.747E-01	.829E-01	.942	1.64
18.9	.208	.157	.181	.455E-01	.333E-01	.148E-01	.508E-01	.102	.265	.302	1.74	3.11
26.6	.132	.233	.450	.203	.149	.252	.184	.301	.455	1.29	2.47	6.12
37.7	.444E-01	.319	.359	.277	.463	.445	.437	.721	1.29	4.91	5.92	15.2
53.2	0.00	.126	.757E-01	.354	.227	.721	1.17	.854	2.47	14.4	10.0	30.4
75.2	0.00	0.00	0.00	.181	.306	.147	.457	.603	3.23	24.7	4.27	33.9
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.462	7.87	.293	8.63
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of sphalerite	.703	.921	1.19	1.13	1.25	1.65	2.33	2.66	8.27	53.6	26.3	100.0

DEF 529 MINOVA 150-200 512*512

Table A-4: Liberation data for sphalerite in the -106+75 μm (-150+200 mesh) size fraction.

table # 5 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the sp grain microns	Classes of sphalerite-bearing particles [% Vol.] 3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		Size Dist. %
	.234E-01	.833E-02	.252E-02	.219E-02	.177E-02	.325E-03	0.00	0.00	0.00	0.00	0.00	452E-01
3.35	.466E-01	.223E-01	.148E-01	.186E-01	.648E-02	.115E-01	.269E-02	.513E-02	530E-02	.168E-02	.934E-01	226
4.71	.727E-01	.337E-01	.377E-01	.380E-01	.190E-01	.146E-01	.148E-01	.385E-01	.156E-01	.115E-01	1.29	.58
6.63	.104	.804E-01	.603E-01	.877E-01	.473E-01	.677E-01	.603E-01	.655E-01	.776E-01	.120	2.31	3.08
9.45	.837E-01	.176	.922E-01	.157	.165	.185	.136	.240	.224	.482	5.32	7.18
13.3	.153E-01	.940E-01	.385	.373	.299	.281	.263	.265	.576	2.09	7.34	12.0
18.9	0.00	.631E-01	.131	.425	.385	.367	.424	.710	1.43	7.36	18.6	29.9
26.6	0.00	0.00	0.00	.148	0.00	.302	.315	.822	1.45	13.9	16.8	33.8
37.7	0.00	0.00	0.00	0.00	0.00	0.00	.122	.160	.816	6.97	3.87	11.9
53.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.254	254
75.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of sphalerite	351	.478	.724	1.24	.923	1.15	1.34	2.31	4.60	31.0	55.9	100.

DEF 529 -200 M -200+325 512*512

Table A-5: Liberation data for sphalerite in the -75+45 µm (-200+325 mesh) size fraction.

table # 5 SUMS
variable z: PER CENT
variable x: PHASE%
variable y: DIAMIC%

Diameter of the sp grain microns	Classes of sphalerite-bearing particles [% Vol.]										Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	361E-01	.174E-01	.124E-01	.137E-01	.434E-02	.157E-01	.103E-01	.798E-02	.147E-02	.504E-02	.780E-01	.282
4.73	904E-01	.336E-01	.257E-01	.883E-02	.281E-01	.304E-01	.344E-01	.542E-02	.291E-01	.205E-01	.675	.981
6.69	982E-01	.442E-01	.294E-01	.219E-01	.262E-01	.555E-01	.666E-01	.392E-01	.158	.122	1.13	1.79
9.46	162	.126	.180E-01	.471E-01	.181E-01	.167E-01	.605E-01	.821E-01	.297	.339	1.51	2.68
13.3	316E-01	.266	.311	.237	.119	.936E-01	.170	.235	.415	.777	2.00	4.66
18.9	0.00	.910E-01	.378	.354	.323	.677	.520	.783	1.60	4.65	3.14	12.5
26.6	0.00	0.00	.621E-01	.169	.740	.393	.978	1.83	3.94	22.1	7.21	37.4
37.7	0.00	0.00	0.00	0.00	.130	.144	.124	.536	1.82	29.5	3.93	36.2
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.61	.912	3.52
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of sphalerite	.418	.578	.837	.852	1.39	1.43	1.96	3.52	8.26	60.2	20.6	100.

DEF 523 MINOVA +400 512*512

Table A-6: Liberation data for sphalerite in the -45+38 µm (-325+400 mesh) size fraction.

DEF 529 -400 M MIN 19.0 512*512

table # 5 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the sp grain microns	Classes of sphalerite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.723E-02	.381E-02	.223E-02	.223E-02	.421E-02	.145E-02	0.00	0.00	0.00	0.00	.212E-01
4.75	.223E-01	.242E-01	.591E-02	.591E-02	.407E-02	.152E-01	.881E-02	.486E-02	.499E-02	0.00	.156
6.69	.442E-01	.221E-01	.173E-01	.631E-02	.315E-02	.214E-01	.218E-01	.325E-01	.313E-01	.103E-01	1.58
9.45	.329E-01	.474E-01	.230E-01	.102	.189E-01	.430E-01	.267E-01	.986E-02	.151	.783E-01	2.77
13.3	.166E-01	.128	.513E-01	.602E-01	.134E-01	.262E-01	.138	.119	.179	.531	4.51
18.9	0.00	.132	.991E-01	.162	.407E-01	.150	.215	.815E-01	.271	.874	5.97
26.6	0.00	0.00	.891E-01	.653E-01	.438	.564E-01	.117	.259	.815	3.07	11.4
37.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.413	1.06	12.2	24.0
53.2	0.00	0.00	0.00	0.00	0.00	0.00	.218	0.00	1.58	11.9	26.0
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.855	.855
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of sphalerite	.123	.358	.286	.404	.522	.314	.746	.919	4.09	28.7	63.5	100.

DEF 529 -400 M MIN 19.0 512*512

Table A-7: Liberation data for sphalerite in the -38 μm (-400 mesh) size fraction.

0 0 2 SUMS PY
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the py grain microns	Classes of pyrite-bearing particles [% Vol.] 9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		Size Dist. %
3.35	.144	.744E-01	.315E-01	.954E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.259
4.73	.114	.658E-01	.735E-01	.496E-01	.238E-01	.544E-01	.131E-01	0.00	0.00	0.00	.401E-01	.441
6.69	.178	.534E-01	.128	.363E-01	0.00	.410E-01	.391E-01	.343E-01	.286E-01	.639E-01	.485	1.09
9.45	.130	0.00	.591E-01	.128	.175	.143	.677E-01	.839E-01	.197	.801E-01	1.06	2.13
13.3	.185	0.00	.117	0.00	0.00	.197	.221	.248	.256	.647	.490	2.36
18.9	0.00	0.00	.222	0.00	0.00	.319	0.00	0.00	.691	1.37	2.10	4.70
26.6	0.00	.451	.436	0.00	0.00	.459	0.00	0.00	.538	1.79	1.07	4.75
37.7	1.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.69	2.14	5.48
53.2	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	0.00	4.83	1.89	12.7
75.2	0.00	0.00	0.00	5.11	0.00	0.00	0.00	0.00	0.00	0.00	3.28	8.39
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.67	8.45	14.5	0.00	30.6
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.1	10.9	27.0
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrite	2.41	.645	1.07	5.33	.198	7.21	.347	8.04	10.2	41.1	23.5	100.

DEF 529 +65 M MINOVA 512*512

Table A-8: Liberation data for pyrite in the +212 µm (+65 mesh) size fraction.

DEF 529 MINOVA -65+100 512*512

table # 2 SUMS
variable z: PER CENT
variable x: PHASEx
variable y: DIA(MIC)

Diameter of the py grain microns	Classes of pyrite-bearing particles [% Vol.]											Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		
3.35	.464E-01	.881E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.552E-01
4.73	.218	.620E-01	.183E-01	.264E-01	.105E-01	0.00	0.00	0.00	0.00	0.00	0.00	.335
6.69	.569	.196	.922E-01	.962E-01	.637E-01	.847E-01	.186E-01	.576E-02	.234E-01	.712E-02	.905E-01	1.25
9.45	1.00	.256	.114	.171	.691E-01	.756E-01	.251E-01	.617E-01	.424E-01	.308E-01	.469	2.32
13.3	.921	.412	.200	.142	.139	.437E-01	.124	.258E-01	.117	.291E-01	.894	3.05
18.9	.994	.606	.157	.262	.461E-01	0.00	.178	.141	.390E-01	.361	1.43	4.21
26.5	.932E-01	.694	.339	0.00	.417	.103	.786E-01	.195	.158	.824	2.82	5.72
37.7	0.00	0.00	.226	1.01	.144	0.00	.491	.149	.639	2.32	5.00	9.98
53.2	0.00	0.00	0.00	0.00	0.00	0.00	.274	1.16	2.14	5.97	4.65	14.4
75.2	0.00	0.00	0.00	0.00	0.00	.605	.767	0.00	.742	17.1	3.06	22.3
106.	0.00	0.00	0.00	0.00	0.00	1.61	0.00	1.11	1.91	12.8	0.00	17.5
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.62	11.3	0.00	14.0
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.99	0.00	4.99
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrite	3.84	2.23	1.15	1.71	.890	2.52	1.95	2.84	8.42	55.6	18.6	100.0

DEF 529 MINOVA -65+100 512*512

Table A-9: Liberation data for pyrite in the -212+150 µm (-65+100 mesh) size fraction.

table # 2 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the py grain microns	Classes of pyrite-bearing particles [% Vol.]										Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.106	.893E-02	.609E-02	.853E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.130
4.73	.432	.402E-01	.244E-01	.142E-01	.130E-01	.219E-01	.313E-01	.609E-02	.812E-02	0.00	.264E-01	.670
6.69	.445	.654E-01	.118E-01	.719E-01	.504E-01	.227E-01	.508E-01	0.00	.142E-01	0.00	.221	.954
9.45	.606	0.00	.227E-01	.341E-01	.453E-01	.735E-01	.199E-01	0.00	.321E-01	.522E-01	.430	1.32
13.3	.530	0.00	0.00	.642E-01	0.00	.152	.884E-01	.935E-01	.439E-01	.231	.652	1.86
18.9	.463	.938E-01	0.00	0.00	0.00	0.00	0.00	.751E-01	.251	.373	1.33	2.58
26.6	.212	.461	.473	0.00	.165	.272	0.00	0.00	0.00	1.11	1.60	4.30
37.7	0.00	.813	.396	0.00	0.00	.394	.237	.482	1.16	5.27	4.38	13.8
53.2	0.00	0.00	0.00	0.00	0.00	0.00	1.84	2.38	1.77	14.5	6.49	26.3
75.2	0.00	0.00	0.00	1.41	0.00	0.00	0.00	0.00	0.00	25.1	5.29	31.8
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83	2.75	0.00	5.58
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.1	10.1	
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrite	2.86	1.48	.940	1.60	.273	.936	2.32	2.96	6.12	49.4	31.2	100.0

DEF 523 MINOVA -100+150 512*512

Table A-10: Liberation data for pyrite in the -150+106 µm (-100+150 mesh) size fraction.

table # 2 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIAMIG

Diameter of the py grain microns	Classes of pyrite-bearing particles [% Vol.]											Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		
3.35	.356E-01	.565E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.412E-01
4.73	.152	.201E-01	.816E-02	.481E-02	.188E-02	0.00	0.00	0.00	0.00	0.00	0.00	.187
6.69	.645	.400E-01	.241E-01	.920E-02	.293E-02	.137E-01	.151E-01	.502E-02	.481E-02	.439E-02	.571E-01	.827
9.45	.895	.814E-01	.305E-01	.502E-01	.232E-01	0.00	.209E-01	.126E-01	0.00	.795E-02	.335	1.46
13.3	.763	.155	0.00	.349E-01	.126E-01	0.00	0.00	.496E-01	.812E-01	.257E-01	.770	1.69
18.9	.699	.104	.772E-01	.374E-01	.590E-01	0.00	.400E-01	.215E-01	.784E-01	.127	1.14	2.38
26.6	.168	.218	0.00	0.00	.113	.784E-01	.194	.975E-01	.437E-01	.739	1.92	3.57
37.7	0.00	.214	0.00	.982E-01	.668	0.00	.375	.496	.219	2.75	4.85	9.66
53.2	0.00	0.00	.547	.480	.226	0.00	.470	.395	2.07	12.9	10.6	27.7
75.2	0.00	0.00	0.00	0.00	0.00	.492	0.00	.929	1.71	20.0	11.8	34.8
106.	0.00	0.00	0.00	0.00	0.00	.665	.731	0.00	.694	10.1	5.29	17.4
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrite	3.36	.639	.687	.707	1.11	1.25	1.65	2.01	4.90	46.6	36.7	100.

Table A-11: Liberation data for pyrite in the -106+75 µm (-150+200 mesh) size fraction.

table # 2 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIAMIC

Diameter of the py grain microns	Classes of pyrite-bearing particles [% Vol.]											Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		
3.35	.231	.383E-01	.826E-02	.151E-01	.207E-02	.252E-02	0.00	0.00	0.00	0.00	0.00	.297
4.73	.150	.493E-01	.202E-01	.156E-01	0.00	.188E-01	.112E-01	.505E-02	0.00	0.00	.640E-01	.335
6.69	.109	.328E-01	.376E-01	.126E-01	.172E-01	.301E-01	.480E-01	.101E-01	.788E-02	.181E-01	.924	1.25
9.45	.255E-01	.264E-01	.441E-01	.714E-01	.112E-01	.106E-01	.590E-01	.909E-01	.597E-01	.103	1.80	2.30
13.3	.225E-01	0.00	.594E-01	.383E-01	.581E-01	.236E-01	.220	0.00	.269	.338	3.43	4.46
18.9	0.00	.629E-01	0.00	.124	.132	.151	.134	.466E-01	.435	1.12	7.17	9.38
26.6	0.00	0.00	.382E-01	0.00	0.00	.127	.633	.232	1.02	4.29	16.6	23.0
37.7	0.00	0.00	0.00	0.00	.376	.172	.216	.355	.825	13.0	26.7	42.2
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.345	6.63	7.84	16.8
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
213.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrite	.537	.210	.268	.277	.597	.536	1.32	1.34	2.96	27.5	64.5	100.0

DEF 523 -200 M -200+325 512*512

Table A-12: Liberation data for pyrite in the -75+45 µm (-200+325 mesh) size fraction.

DEF 529 MINOVA +400 512*512

table # 2 SUMS
variable z: PER CENT
variable x: PHASEx
variable y: DIA(MIC)

Diameter of the py grain microns	Classes of pyrite-bearing particles [% Vol.]										Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.33	.971	.156	.802E-01	.437E-01	.538E-01	.825E-01	.365E-01	.201E-01	.118E-01	.633E-02	.903E-01	1.55
4.73	.898	.489E-01	.233E-01	.224E-01	.653E-01	.475E-01	.558E-01	.737E-01	.900E-01	.334E-01	.448	1.81
6.69	.626	.276E-01	.164E-01	.242E-01	.512E-01	.633E-01	.319E-01	.162	.192	.208	.551	1.95
9.45	.247	.190	.285E-01	0.00	.135	.920E-01	.368E-01	.137	.455	.393	.833	2.55
13.3	.647E-01	.190	.805E-01	0.00	.185	0.00	.287	.147	.523	.855	.709	2.96
18.9	0.00	.132	.128	.169	.441	.413	.618	.705	3.82	3.99	1.52	11.9
26.6	0.00	0.00	0.00	.264	0.00	1.39	2.81	2.76	6.81	16.6	2.21	32.8
37.7	0.00	0.00	0.00	0.00	0.00	.915	0.00	1.21	11.5	25.3	2.52	41.5
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.36	0.00	2.36
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrite	2.81	.745	.357	.523	.850	3.00	3.88	5.22	23.4	50.3	8.88	100.0

DEF 529 MINOVA +400 512*512

Table A-13: Liberation data for pyrite in the -45+38 µm (-325+400 mesh) size fraction.

table # 2 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the py grain microns	Classes of pyrite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.298	.300E-01	.921E-01	.550E-01	.598E-01	.119E-01	0.00	0.00	0.00	0.00	.607
4.73	.313	.164	.126	.878E-01	.614E-01	.122	.787E-01	.291E-01	.108E-01	0.00	1.14
6.69	.259	.160	.131	.862E-01	.176	.781E-01	.147	.215	.992E-01	.129E-01	1.13
9.45	.593E-01	.291E-01	.307E-01	.124	.129	.110	.151	.868E-01	.247	.127	1.74
13.3	.485E-01	0.00	0.00	0.00	0.00	.328	.101	.727E-01	.320	.635	4.09
18.9	0.00	.116	0.00	0.00	.131	0.00	.175	.228	.421	1.89	5.21
26.6	0.00	0.00	0.00	0.00	0.00	0.00	.280	.562	1.54	4.41	10.2
37.7	0.00	0.00	0.00	0.00	0.00	0.00	.526	.506	1.57	11.0	24.3
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.841	10.4	11.1
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83	1.83
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrite	.977	.558	.379	.354	.558	.650	1.46	1.70	5.05	30.3	58.0	100.0

DEF 529 -400 M MIN 19.0 512*512

Table A-14: Liberation data for pyrite in the -38 μm (-400 mesh) size fraction.

table # 3 SUMS po
variable z: PER CENT
variable x: PHASEx
variable y: DIA(MIC)

Diameter of the po grain microns	Classes of pyrrhotite-bearing particles [% Vol.] 9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		Size Dist. %
3.35	.144	.423E-01	.276E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.214
4.73	.284	.729E-01	.640E-01	.492E-01	.128E-01	.630E-01	.355E-01	0.00	0.00	.620E-01	.414E-01	.684
6.69	.111	.345E-01	.143	.660E-01	.105	.502E-01	.542E-01	.100	.138	.370	.696	1.87
9.45	.955E-01	0.00	.280	.208	.130	.220	.112	.219	.422	1.16	.595	3.44
13.3	.926E-01	.314	.113	.400	.545	.205	.100	.404	.627	1.54	.646	4.99
18.9	.767	.191	0.00	0.00	.296	0.00	0.00	.239	.328	1.46	.856	4.14
26.6	.698	0.00	.521	0.00	0.00	.899	0.00	.464	1.28	1.93	0.00	5.79
37.7	1.61	1.35	1.26	0.00	0.00	0.00	0.00	0.00	0.00	5.49	0.00	9.70
53.2	0.00	2.34	0.00	4.57	0.00	0.00	1.79	0.00	0.00	1.43	0.00	10.1
75.2	3.10	0.00	0.00	0.00	3.79	0.00	0.00	0.00	3.98	9.57	0.00	20.4
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.72	0.00	8.72
150.	0.00	0.00	0.00	0.00	0.00	0.00	16.4	0.00	0.00	13.4	0.00	29.9
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrrhotite	6.90	4.34	2.41	5.29	4.68	1.44	18.5	1.43	6.77	45.2	2.83	100.

DEF 529 +65 M MINOVA 512*512

Table A-15: Liberation data for pyrrhotite in the +212 µm (+65 mesh) size fraction.

DEF 523 MINOVA -65+100 512*512

table # 3 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the po grain microns	Classes of pyrrhotite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.574E-01	.583E-02	.762E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.709E-01
4.73	.276	.404E-01	.534E-01	.229E-01	.144E-01	0.00	0.00	0.00	0.00	0.00	.407
6.69	.666	.248	.116	.104	.709E-01	.120	.265E-01	.431E-01	.193E-01	.175E-01	.139	1.57
9.45	.898	.326	.187	.227	.164	.592E-01	.369E-01	.166	.444E-01	.713E-01	.461	2.70
13.3	1.54	.271	.368	.172	.324	.226	.373	.380	.373	.488	1.06	5.59
18.9	.734	.743	.446	.278	.178	.122	.202	.466	.86[illegible]	.697	1.22	6.01
26.6	.567	.865	.857	.635	.624	.687	.744	1.24	.790	3.18	.396	10.6
37.7	.584	.455	1.66	1.66	.773	.943	1.72	1.89	3.97	9.04	1.02	23.7
53.2	0.00	.473	.366	.556	1.10	1.21	3.07	2.01	3.04	10.1	.362	22.3
75.2	0.00	0.00	0.00	0.00	0.00	0.00	.888	2.60	3.51	7.48	0.00	14.5
106.	0.00	0.00	0.00	0.00	0.00	1.43	1.45	0.00	0.00	5.59	0.00	8.47
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.09	0.00	4.09
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrrhotite	5.38	3.43	4.06	3.66	3.25	4.80	8.57	8.79	12.6	40.8	4.66	100.

DEF 523 MINOVA -65+100 512*512

Table A-1 : Liberation data for pyrrhotite in the -212+150 µm (-65+100 mesh) size fraction.

DEF 529 MINOVA -100+150 512*512

table # 3 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the po grain microns	Classes of pyrrhotite-bearing particles [% Vol.]											Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		
3.35	.102	.101E-01	.810E-02	.456E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.124
4.73	.356	.491E-01	.435E-01	.709E-02	.370E-01	.643E-01	.911E-02	0.00	.111E-01	0.00	.319E-01	.609
6.69	.564	.486E-01	.668E-01	.704E-01	.304E-01	.516E-01	0.00	.370E-01	.116E-01	.678E-01	.218	1.17
9.45	1.12	.582E-01	0.00	.326E-01	.714E-01	.159	.673E-01	.623E-01	.614E-01	.154	.400	2.25
13.3	.918	.581	.135	.299	0.00	.790E-01	.511E-01	.275	.108	.322	1.17	3.94
18.9	1.08	.481	.214	.395	0.00	.110	.247	0.00	.447	.386	1.09	4.45
26.6	.503	.471	.870	.844	0.00	.868	.553	0.00	.957	2.78	1.12	8.97
37.7	0.00	1.23	0.00	1.55	.534	0.00	0.00	.656	1.04	6.12	1.06	12.3
53.2	0.00	0.00	0.00	0.00	0.00	0.00	2.12	0.00	2.75	18.3	.987	24.1
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.57	17.3	2.18	29.0
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.07	10.0	0.00	13.1
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrrhotite	4.65	2.99	1.34	3.27	.673	1.33	3.05	1.03	18.0	55.4	8.27	100.

DEF 529 MINOVA -100+150 512*512

Table A-17: Liberation data for pyrrhotite in the -150+106 μm (-100+150 mesh) size fraction.

table # 3 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the po grain microns	Classes of pyrrhotite-bearing particles [% Vol.] 9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		Size Dist. %
3.35	.205E-01	.998E-03	.148E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.230E-01
4.73	.137	.916E-02	.619E-02	.841E-02	.495E-02	.297E-02	0.00	0.00	0.00	0.00	0.00	.169
6.69	.524	.693E-01	.356E-01	.232E-01	.144E-01	.376E-01	.158E-01	.156E-01	0.00	0.00	.844E-01	.826
9.45	.869	.812E-01	.603E-01	.114E-01	.582E-01	.349E-01	.342E-01	.562E-01	.559E-01	.168E-01	.384	1.66
13.3	.732	.170	.843E-01	0.00	.120	.113	.775E-01	.153	.168	.115	.669	2.46
18.9	.786	.806	.346	.646E-01	.636E-01	.683E-01	.117	.273	.105	.480	.763	3.88
26.6	.300	.536	.310	.482	.652	.145	.473	.600	.580	1.38	.664	6.12
37.7	0.00	.111	.365	.496	.882	.935E-01	1.95	1.59	1.89	6.84	2.34	17.8
53.2	0.00	0.00	.225	.242	.768	1.18	1.78	3.15	2.89	12.0	1.75	23.9
75.2	0.00	0.00	0.00	0.00	0.00	.852	1.32	1.98	4.86	24.8	2.51	36.3
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.830	0.00	6.02	0.00	6.85
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrrhotite	3.43	1.78	2.84	1.33	2.56	2.54	5.77	8.65	10.5	51.6	9.76	100.

REF 523 MINOVA 150-200 512*512

Table A-18: Liberation data for pyrrhotite in the -106+75 µm (-150+200 mesh) size fraction.

table # 3 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the po grain microns	Classes of pyrrhotite-bearing particles [% Vol.]										Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.173	.154E-01	.218E-01	.162E-01	.568E-02	0.00	0.00	0.00	0.00	0.00	.232
4.73	.178	.562E-01	.134E-01	.277E-01	.269E-01	.316E-01	.291E-01	.504E-02	.165E-01	.456E-01	.727E-01 .503
6.69	.405	.178	.117	.176E-01	.394E-01	.526E-01	.453E-01	.121	.758E-01	.573	.853 2.48
9.45	.245	.374	.218	.123	.139	.101	.832E-01	.218	.335	1.90	1.05 4.79
13.3	.143	.421	.398	.239	.359	.518	.299	.243	.869	4.17	1.61 9.27
18.9	.509E-01	.376	.639	.904	.744	1.02	.453	.707	.548	7.86	1.99 15.3
26.6	0.00	.119	.142	.576	.700	.851	1.31	1.44	1.79	20.8	1.95 29.6
	0.00	0.00	.218	0.00	.209						
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.76	7.19	0.00 0.95
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 0.00
Dist. of pyrrhotite	.20	1.54	1.77	1.98	2.22	3.79	3.82	4.27	7.81	63.1	8.52 100.

529 -200 M -200+325 512*512

Table A-19: Liberation data for pyrrhotite in the -75+45 μm (-200+325 mesh) size fraction.

DEF 529 MINOVA +400 512*512

table # 3 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the po grain microns	Classes of pyrrhotite-bearing particles [% Vol.] 3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		Size Dist. %
3.85	1.28	.278	.116	.104	.704E-01	.547E-01	.310E-01	.104E-01	.135E-01	.211E-01	.154	2.13
4.73	1.86	.189	.170	.107	.336E-01	.882E-01	.582E-01	.126	.781E-01	.300E-01	.731	3.47
6.59	2.56	.365	.946E-01	.676E-01	.137	.969E-01	.197	.202	.140	.143	1.14	5.15
9.45	1.35	.884	.142	.598E-01	.199	.343E-01	.148	.168	.279	.368	1.31	4.94
13.3	.104	1.10	.638	.307	.434	.182	.158	.288	.394	.843	1.30	6.34
18.9	0.00	.139	1.06	1.02	1.42	.663	.807	.751	1.87	4.86	3.15	15.7
26.6	0.00	0.00	.200	.877	1.27	1.18	2.42	3.66	4.53	19.2	3.24	36.6
37.7	0.00	0.00	0.00	0.00	0.00	0.00	.478	2.40	4.45	15.6	1.66	24.6
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.983	0.00	.983
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrrhotite	7.16	2.95	2.43	3.14	3.57	2.30	4.30	7.61	11.8	42.1	12.7	100.0

DEF 529 MINOVA +400 512*512

Table A-20: Liberation data for pyrrhotite in the -45+38 µm (-325+400 mesh) size fraction.

table # 3 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the po grain microns	Classes of pyrrhotite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.440	.147	.986E-01	.210E-01	.381E-01	0.00	0.00	0.00	0.00	0.00	0.00	.744
4.73	.164	.848E-01	.103	.114	.375E-01	.612E-01	.355E-01	.132E-01	0.00	.259	.710E-01	.944
6.69	.397	.182	.170	.245	.212	.217	.157	.200	.120	1.25	.413	3.56
9.45	.326	.612E-01	.240	.401	.254	.498	.312	.498	.406	2.34	.235	5.57
13.3	.658E-01	.253	.326	.449	.256	.266	.612	.775	1.85	5.29	.197	10.3
18.9	0.00	.126	.342	.608	.402	1.16	.894	.563	1.86	7.38	0.00	13.3
26.6	0.00	0.00	.251	.891	1.79	1.91	1.57	3.14	6.42	13.0	0.00	28.9
37.7	0.00	0.00	0.00	0.00	0.00	1.74	2.78	3.18	6.39	13.8	0.00	27.9
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.19	5.53	1.98	0.00	8.71
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of pyrrhotite	1.39	.854	1.53	2.73	2.99	5.84	6.36	9.56	22.6	45.2	.916	100.

DEF 529 -400 M MIN 19.0 512*512

Table A-21: Liberation data for pyrrhotite in the -38 μm (-400 mesh) size fraction.

table # 4 SUMS ch.
variable z: PER CENT
variable x: PHASEX
variable y: DIAMHIC

Diameter of the ch grain microns	Classes of chalcopyrite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.514E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.514E-01
4.73	.486E-01	0.00	0.00	0.00	0.00	0.00	0.00	.514E-01	0.00	0.00	0.00	.100E+00
6.69	.186	0.00	.117	0.00	.943E-01	0.00	0.00	0.00	0.00	0.00	.543	.940
9.45	.380	0.00	0.00	.154	0.00	0.00	.163	0.00	0.00	.631	.863	2.19
13.3	0.00	0.00	.274	0.00	0.00	0.00	0.00	.326	0.00	.411	.486	1.50
18.9	3.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.568	0.00	3.71
26.6	1.50	0.00	0.00	0.00	0.00	1.78	0.00	0.00	0.00	0.00	0.00	3.28
37.7	0.00	9.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.61
53.2	0.00	9.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.48
75.2	0.00	8.71	0.00	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	19.7
106.	0.00	0.00	31.5	18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.4
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of chalcopyrite	5.31	27.8	31.9	18.1	11.1	1.78	.163	.377	0.00	1.61	1.89	100.0

DEF 529 +65 M MINOVA 512*512

Table A-22: Liberation data for chalcopyrite in the +212 µm (+65 mesh) size fraction.

table # 4 SUMS
variable z: PER CENT
variable x: PHASEx
variable y: DIA(MIC)

Diameter of the ch grain microns	Classes of chalcopyrite-bearing particles [% Vol.]											Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		
3.35	.588E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.588E-01
4.73	.460E-01	.665E-01	.281E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.141
6.69	.703	.199	.146	.397E-01	0.00	.844E-01	0.00	0.00	0.00	0.00	0.00	1.23
9.45	4.05	.473	.478	.307	.187	.125	.286	.304	.274	.176	.371	7.03
13.3	2.98	1.23	1.21	1.10	.660	.481	1.16	.217	.821	.197	.368	10.4
18.9	2.13	2.18	.946	1.23	.231	.741	.578	1.93	1.000	.432	.294	11.8
26.6	2.00	.647	2.16	.578	.555	3.82	2.15	.529	.511	2.73	0.00	15.7
37.7	0.00	4.25	2.58	4.13	0.00	3.04	4.36	3.63	5.82	1.30	0.00	29.1
53.2	0.00	0.00	0.00	0.00	0.00	0.00	3.29	3.50	0.00	5.80	0.00	12.6
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.42	7.58	0.00	12.0
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of chalcopyrite	12.0	9.04	7.55	7.44	1.69	8.29	11.8	10.1	12.8	18.2	1.03	100.

DEM 523 MINOVA -65+100 512*512

Table A-23: Liberation data for chalcopyrite in the -212+150 µm (-65+100 mesh) size fraction.

table # 4 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the ch grain microns	Classes of chalcopyrite-bearing particles [% Vol.] 3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0		Size Dist. %
3.35	.470E-01	.476E-01	0.00	.374E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.132
4.75	530	.680E-01	0.00	0.00	.476E-01	.544E-01	.578E-01	0.00	0.00	0.00	0.00	.758
6.69	.56	0.00	.306	0.00	0.00	.317E-01	0.00	0.00	.217	.385E-01	.221	2.43
9.45	3.84	0.00	0.00	0.00	0.00	.404	0.00	.248	0.00	0.00	.173	4.67
13.3	4.37	1.06	0.00	.353	0.00	0.00	0.00	0.00	0.00	.360	0.00	6.75
18.9	4.57	1.12	.799	2.62	1.23	1.63	0.00	0.00	0.00	.758	0.00	12.8
26.6	1.23	2.61	1.77	0.00	1.36	0.00	1.77	2.18	2.41	0.00	0.00	13.2
37.7	0.00	2.75	3.32	0.00	5.75	6.12	0.00	0.00	0.00	2.46	0.00	28.4
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.2	0.00	15.1	0.00	28.3
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.4	0.00	10.4
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of chalcopyrite	16.7	7.66	6.20	3.01	8.45	8.36	1.82	15.5	2.63	29.2	.334	100.0

PGM523 MINOVA -100+150 512*512

Table A-2: Liberation data for chalcopyrite in the -150+106 µm (-100+150 mesh) size fraction.

table # 4 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the ch grain microns	Classes of chalcopyrite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.135E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.135E-01
4.73	.647E-01	.966E-02	.116E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.860E-01
6.69	.715	.111	0.00	.753E-01	.222E-01	.367E-01	.232E-01	0.00	0.00	0.00	.638E-01	1.05
9.45	2.31	.356	.889E-01	.233	.821E-01	0.00	.108	0.00	0.00	0.00	.205	3.38
13.3	3.24	.711	.180	.113	.134	.560E-01	.213	.168	.129	.187	.152	5.29
18.9	3.36	2.09	1.34	.129	.281	.112	.275	.700	.196	1.13	.277	9.35
26.6	1.53	3.88	2.61	2.37	.343	.352	.239	1.12	.786	.943	0.00	14.8
37.7	.398	2.82	6.33	3.04	1.65	.821	.565	1.06	2.00	5.57	0.00	24.3
53.2	0.00	0.00	.870	.781	2.13	2.61	3.83	1.23	.910	8.20	0.00	20.6
75.2	0.00	0.00	1.54	1.63	0.00	2.11	2.12	1.52	2.30	5.32	0.00	17.1
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	0.00	0.00	3.50
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of chalcopyrite	11.6	9.97	13.0	8.37	4.64	6.70	7.37	5.80	9.83	22.0	.697	100.

DEC 529 MINOVA 150-200 512*512

Table A-25: Liberation data for chalcopyrite in the -106+75 μm (-150+200 mesh) size fraction.

DEF 529 -200 M -200+325 512*512

table # 4 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the ch grain microns	Classes of chalcopyrite-bearing particles [% Vol.]										Size Dist. %
	3.33	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.266E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.266E-01
4.73	.266E-01	.196E-01	.266E-01	.413E-01	.307E-01	.210E-01	0.00	0.00	0.00	.615E-01	.228
6.69	.413	.116	.992E-01	.211	.161	.587E-01	.363E-01	0.00	0.00	.503E-01	.252
9.45	1.49	.343	.629	.478	.186	.259	.194	.284	.763	.340	1.67
13.3	.439	1.79	1.17	1.06	1.23	.309	.690	.600	1.28	1.93	2.06
18.9	0.00	1.45	1.55	1.38	.535	.309	.365	.845	.573	2.26	2.76
26.6	0.00	0.00	.552	.541	0.00	3.04	1.39	4.89	3.22	11.2	4.27
37.7	0.00	0.00	0.00	0.00	1.01	2.11	2.96	1.20	4.20	12.7	6.16
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.71	4.37	0.00
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of chalcopyrite	2.40	4.32	4.02	3.72	3.16	6.11	5.64	7.74	12.8	32.9	17.2	100.

DEF 529 -200 M -200+325 512*512

Table A-26: Liberation data for chalcopyrite in the -75+45 µm (-200+325 mesh) size fraction.

table # 4 SUMS
variable z: PER CENT
variable x: PHASEX
variable y: DIA(MIC)

Diameter of the ch grain microns	Classes of chalcopyrite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	1.11	.639E-01	.169	.788E-01	.105	.204E-01	.334E-01	.352E-01	.222E-01	0.00	.630E-01	1.70
4.73	3.08	.262	.277	.133	.157	.343E-01	.250E-01	0.00	.306E-01	.769E-01	.137	4.21
6.69	3.29	.742	.473E-01	.122	0.00	.104	.222	.500E-01	.148	.152	.243	5.12
9.45	1.96	2.10	.960	.629	.180	0.00	.566	.512	.658	.554	.245	8.36
13.3	.460	2.21	2.38	1.03	0.00	.224	0.00	.512	.355	1.01	0.00	8.19
18.9	0.00	.772	.758	2.47	2.23	0.00	1.25	0.00	1.14	6.02	1.09	15.7
26.6	0.00	0.00	0.00	0.00	1.76	2.49	1.84	2.13	6.67	6.29	1.00	22.2
37.7	0.00	0.00	0.00	0.00	1.65	2.37	0.00	2.56	4.08	20.9	0.00	31.6
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.93	0.00	2.93
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of chalcopyrite	9.89	6.15	4.59	4.47	6.08	5.25	3.94	5.81	13.1	37.9	2.78	100.0

DEF 523 MINOVA +400 512*512

Table A-27: Liberation data for chalcopyrite in the -45+38 µm (-325+400 mesh) size fraction.

table # 4 SUMS
variable z: PER CENT
variable x: PHASEx
variable y: DIA(MIC)

Diameter of the ch grain microns	Classes of chalcopyrite-bearing particles [% Vol.]										Size Dist. %
	9.99	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	
3.35	.534E-01	.244E-01	.929E-02	.813E-02	.116E-01	0.00	0.00	0.00	0.00	0.00	.107
4.73	0.00	.122	.244E-01	0.00	.203E-01	.476E-01	.163E-01	.441E-01	0.00	.255E-01	.301
6.69	.358	.883E-01	.290	.279E-01	.172	.175	.662E-01	.134	.323	.118	.483	2.24
9.45	1.98	1.28	.566	.751	.478	1.05	.648	.243	.893	.633	1.42	9.34
13.3	1.56	2.17	1.55	.766	.667	.170	.761	.847	1.86	2.07	.961	13.4
18.9	.274	1.67	4.04	.757	1.50	1.22	.963	1.21	1.87	3.74	1.17	18.4
26.6	0.00	0.00	.614	2.03	2.16	3.47	2.73	5.55	4.12	4.31	1.17	26.2
37.7	0.00	0.00	0.00	0.00	2.16	0.00	3.38	4.72	3.63	8.01	0.00	21.9
53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.93	4.55	0.00	7.48
75.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dist. of chalcopyrite	4.24	5.35	7.10	4.34	7.17	6.14	8.62	12.7	15.6	23.4	5.23	100.0

523 -400 M MIN 19.0 512*512

Table A-28. Liberation data for chalcopyrite in the -38 μm (-400 mesh) size fraction.